

Learning Resources for Medical Computing

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For medical professionals to acquire computer literacy can be an arduous task. Resources for learning medical computing fall into four major categories: learning technical microcomputer use, computerizing an office practice, tracking patient care experience and integrating medical information systems. Both microcomputer use and tracking patient care experience are technical skills similar to learning any medical procedure with which physicians are already familiar. These skills can be acquired by consulting general, commercial resources such as computer stores, popular computer magazines or software manuals. Computerizing an office practice involves diagnosing office information problems by thoroughly analyzing how data flow during outpatient care. Medical information system design and management is a cognitive specialty in which principles of computer science and medical information management are applied to patient care experience.

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Physicians frequently ask, "Where can I learn about medical computing?" What they usually mean by this question could be one or more of the following more specific questions:

1. Where can I learn to use a personal computer?
2. What is the best way to computerize my office practice?
3. How can I keep track of my patient care experience?
4. Where can I learn about the fine points of possible medical applications that might be used with the medical information system I work with?

The first question implies wanting to learn a technical skill that is similar to many of the manual skills learned by medical students, such as doing a lumbar puncture, a thoracentesis or a specialty physical examination. The second question implies a desire to solve a not-yet-defined problem. Often a physician has an office manager who is instructed to find an office computer system and implement it to improve cash flow and data retrieval in the practice. The third question presupposes a knowledge of the technical aspects of operating a personal computer and addresses a common desire of many physicians to keep detailed files on specific patient types in their practices. The purpose of this computerization could be to write about their experience or to discover some relationship that will contribute to new medical knowledge about a disease. The fourth question indicates a desire to learn the principles of medical informatics to more effectively computerize and integrate a medical information system according to a physician's professional needs.

The following discussion of learning resources for medical computing has been categorized according to the tenor of the questions asked above.

Learning Technical Microcomputer Use

Many local colleges, vocational schools and, sometimes, dedicated commercial educational centers offer introductory courses in microcomputer use. In a classroom students receive hands-on experience using a particular brand of microcomputer. These courses are places to begin but one should beware of courses that try to teach a programming language using a lecture setting with access to terminals connected to the school's minicomputer. Computer programming is not the best beginning for students who want to learn how to operate and run a specific computer application. Before these introductory "hands-on" courses became available and even to a large extent now, most technical computer skills have been self-learned after a microcomputer has been purchased for home use. Some have been fortunate enough to learn to use a microcomputer in a business or professional setting, but the learning curve for most learners does not rapidly ascend until they have a home unit to practice on. In a sense, this is an expensive way to learn computer use, but, in another sense, it is the only way that consistently works. Attending local computer store courses on the "disk operating system" (DOS) or a specific word processor, data base or spread sheet is the next step, especially if self-learning is thwarted by poorly written manuals. After buying a software applications package, a person can often sit down with the manual and learn how to

operate the program, but an introductory course in that software can save hours of frustration.

Last, general magazines (see Appendix, numbers 1 and 2) and those that are specific to the personal computer to which a person has access (numbers 3 to 8) are a major information source. Reading articles and looking at the ads are popular ways of continuing to learn, and this is especially the case in the personal computer fields. The cost of two to three magazine subscriptions is well worth the expense, even if there is time only to skim the issues periodically.

In general, it takes about two years (on an after-hours basis) after having access to a microcomputer to become accomplished in the technical "how-to-do-it" aspects of computing. During that time a software applications program can be used productively, but it takes most people that long to feel comfortable with adding new hardware components to their computer, obtaining the innumerable little software subroutines necessary to make life easier, adjusting start and stop bits and the baud rate for telecommunications and having the confidence to explore new applications on their own.

As a physician becomes more proficient in using a microcomputer, he or she may decide to write computer programs either for personal use or as development for resale to other users in a particular specialty. There are more advanced magazines available for those who get the "hacker" spirit (Appendix, numbers 9 and 10).

Computerizing an Office Practice

Computerizing an office practice is not itself an educational goal. One physician may want to improve cash flow, whereas another may just want to have better patient data at hand. Some physicians are more interested in computerizing the medical record aspects of their office practices and would prefer to leave accounting to a current manual, batch or service system. Data gathered during a patient visit, such as diagnoses, procedures or therapies, have both medical and financial meaning. There is no point in having a patient's bill give one diagnosis when the physician's medical notes show another, and yet medical data are collected that are unnecessary for the accounts-receivable system.

Alternatively, there is much financial and administrative information that physicians do not want cluttering their medical notes. Information flow in an ambulatory medical setting is much more complicated than most physicians realize. They are aware of their medical data requirements but often do not fully understand their own practice's financial and administrative needs.

If a physician's practice does not currently have an office computer system, I recommend that one or more physicians in a practice become familiar with personal computers before committing to any office software. By spending a year or even two in learning what can and cannot be done with personal computers, physicians will save several thousand dollars or more in computerizing their office system, just by being familiar with computer terminology and with what are reasonable expectations of performance for office software (Appendix, numbers 11 and 12). The next step is to do a thorough analysis of data gathering and information flow in the medical practice (Appendix, number 13). There are usually at least 25 different documents on which a patient's name and medical record number may be written during a single patient visit.

Physicians are usually only familiar with a few of the documents that they personally write on. Receptionists, insurance clerks, nurses and laboratory aides, however, can point out other documents that must be completed during a patient visit. After a thorough assessment of all current data forms is done and a list of current and desired reports is made, it becomes obvious how complex the logistics of data flow in a medical practice really are. Computer systems have been developed to handle all this information flow but they are usually minicomputer based and expensive (Appendix, number 14). If a physician buys a personal computer with one or two terminals and expects it to totally computerize his or her patient care data, a major disappointment awaits both physician and office staff. It is usually better to grow into the data-processing requirements by starting with smaller aspects of the the total patient flow and then determining where the major payoff to computerization will occur. (Appendix, numbers 15 and 16).

Tracking Patient Care Experience

Physicians-in-training learn to collect patient historical and physical data in detail, to organize the medical record along traditional formats and add to the initial assessment a time series of patient encounters focused on a specific medical problem. Personal computers and commercially available data-base managing systems can be used to record this patient care experience for defined medical categories. It is difficult to process the entire medical record for any one of 10,000 possible patient problems on a personal computer, but if physicians want to follow all of their patients who have diabetes mellitus or hypertension, for example, this can and should be done.

To learn this, data-base managing software should be selected that runs on an available microcomputer. There may be courses offered at a local computer store for the more popular selling data-base managing systems, but, for the most part, people learn by sitting down with a computer manual and creating patient files by trial and error. Creating a patient data base is an iterative function in which the data elements and their relationships are defined, sample patient data are recorded, the data elements and their relationships are revised and then actual patient data are recorded. There are usually from three to six different attempts at defining data-base content until a "final" (only for the next six months) format is settled on for regular data entry. Physicians should look for commercially available software packages that:

- Can easily calculate the number of days between two dates.
- Store their records as variable-length free text. (For a last name of "Smith," only 5 characters of storage are allocated instead of 18 characters that users may have defined as the maximum length for a last name.)
- Uses a data dictionary or relational records to accommodate list variables such as diagnoses, procedures, medications, providers and the like.

The above features tend to characterize medical data bases versus features for business data bases. Setting up a simple patient data base is so fundamental to medicine that it should be taught in medical school. Not only is it helpful to practicing physicians, but residents and fellows will find this skill indispensable. Seldom is hiring a programmer to computerize one's records or ordering a computer-literate subordinate to

set up one's programs successful. I used to think these were reasonable alternatives but have learned that information systems should be designed by those people who are the users of the information. In the case of patient care experience, that user is a physician.

Integrating a Medical Information System

All physicians will eventually learn to use a computer as a tool to make the daily practice of medicine more efficient. They may use one for patient case records, as aids to medical decision making or for telecomputing to "dial-up" medical data bases. Only a small subset of those physicians, however, will delve into the cognitive basis of medical informatics (Appendix, numbers 17 and 18). Most physicians will not feel the need to keep aware of informatics development in specialty fields other than their own; to attend scientific presentations on research and development in medical informatics, or to worry about generic problems such as patient identification and record linkage in medicine, the influence of data-recording techniques on error rates in medical data, the advantages and disadvantages of different medical coding and nomenclature systems or the strengths and weaknesses of mathematical-based decision support programs versus rule-based expert systems.*

Those who work with medical information systems on a daily basis or who serve as educators in medical schools will find support in professional associations (Appendix, numbers 19, 20 and 21) and annual symposia and conferences (numbers 22 and 23) that will help keep them up-to-date on current developments. There are peer-reviewed scientific journals that cover this field (numbers 24, 25 and 26) and educational journals (number 27) and newsletters (number 28) that one can use as information resources. Readers who think they might be interested in this degree of informatics involvement should attend one of the fall symposia or spring congresses that are conducted for persons in the medical profession. Following that, a person may want to join a professional organization that includes a subscription to its learning journals and provides forums for sharing problems with others who have similar interests (number 19). For those who remain in the field for several years or obtain advanced degrees in medical informatics, it is possible to look forward to a collegial fellowship of other professionals in medical informatics (number 21) who help define and support this newly emerging medical specialty field.

*See "Medical Expert Systems—Knowledge Tools for Physicians" by E. H. Shortliffe, MD, elsewhere in this issue.

APPENDIX

Resources for Further Information*

Popular Magazines—News and Introductory

1. Byte, Subscription Dept, PO Box 597, Martinsville, NJ 08836
2. InfoWorld, PO Box 1018, Southeastern, PA 19398
3. PC Magazine [IBM compatibles], PO Box 2445, Boulder, CO 80322
4. PC Week [IBM compatibles], Circulation Dept, One Park Ave, 4th Flr, New York, NY 10016
5. PC World [IBM compatibles], Subscription Dept, PO Box 6700, Bergenfield, NJ 07621
6. Macworld (Macintosh), Subscription Dept, PO Box 51666, Boulder, CO 80321
7. A + [Apple, Macintosh], PO Box 40317, Philadelphia, PA 19106
8. Incider [Apple], CW Communications/Peterborough, PO Box 911, Farmingdale, NY 11737

Magazines—Technical

9. PC Tech Journal, PO Box 2968, Boulder, CO 80321
10. Dr Dobb's Software Journal, 2464 Embarcadero Way, Palo Alto, CA 94303

Books—Office Practice

11. Oberst BB, Reid RA (Eds): Computer Applications to Private Office Practice. New York, Springer-Verlag, 1984
12. Neiburger EJ: Computers for Professional Practice. Waukegan, Ill, Andent, Inc, 1984 [1000 North Ave, Waukegan, IL 60085]
13. Jelovsek FR: Doctor's Office Computer Prep Kit. New York, Springer-Verlag, 1985

Books—Overview Medical Informatics

14. Blum BI (Ed): Computers and Medicine: Information Systems for Patient Care. New York, Springer-Verlag, 1984
15. Norris DE, Skilbeck CE, Hayward AE, et al: Microcomputers in Clinical Practice. New York, John Wiley & Sons, 1985
16. Javitt J (Ed): Computers in Medicine: Applications and Possibilities. Philadelphia, WB Saunders, 1986
17. Covey HD, Craven NH, McAlister NH: Concepts and Issues in Health Care Computing, Vol 1. St Louis, CV Mosby, 1985
18. Blois MS: Information and Medicine: The Nature of Medical Descriptions. Berkeley, Calif, University of California Press, 1984

Organizations and Associations

19. American Association for Medical Systems and Informatics (AAMSI), 1101 Connecticut Ave NW, Washington, DC 20036
20. Society for Medical Decision Making, Gamble and Associates, PO Box 447, West Lebanon, NH 03784
21. American College of Medical Informatics, c/o Thomas E. Piemme, MD, Secretary, George Washington University, 2300 K St NW, Washington, DC 20037

Scientific Meetings

22. Symposium for Computer Applications in Medicine (November), The George Washington University Medical Center, Office of Continuing Education, 2300 K St NW, Washington, DC 20037
23. AAMSI Spring Congress (May)

Peer-Reviewed Scientific Journals

24. Computers and Biomedical Research, Academic Press, 6277 Sea Harbor Dr, Orlando, FL 32887
25. Journal of Medical Systems, Plenum Publishing Corp, 233 Spring St, New York, NY 10013
26. Methods of Information in Medicine, F.K. Schättauer Verlag GmbH, 7000 Stuttgart 1, Postfach 2945, Lenzhalde 3, Germany

Educational Journals

27. MD Computing, Springer-Verlag New York Inc., Service Center Secaucus, 44 Hartz Way, Secaucus, NJ 07094

Newsletters—General Medical

28. Computers in Medicine, PO Box 36, Glencoe, IL 60022

*This is not intended to be an exhaustive list but rather provides guidelines for not wasting one's money.